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NATIONAL BUREAU OF STANDARDS REPORT

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Progress Report
on the
Mechanisms of Fire Ignition and Extinguishment
by

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MECHANISMS OF FIRE IGNITION AND EXTINGUISHMENT

1. SUMMARY

A preliminary study was undertaken on the electrical effects during application of dry powders to fires. Technical difficulties seem to make continuation of this work inadvisable at present. Measurements were made of ionization present in fuel mixtures in gases just prior to ignition. The results seem to indicate that preflame reactions do not result in ion formation.

2. EXTINGUISHMENT BY POWDERS

Scaling studies relating the effectiveness of several dry powder extinguishing agents to the area of the fire, were concluded with the publication of a report, No. 6531, "Extinguishment Effectiveness of Some Powdered Materials on Hydrocarbon Fires" by T. G. Lee and A. F. Robertson, dated 8 September 1959. These results were presented at the National Research Council Symposium on the Use of Models in Fire Research, on November 1959.

Preliminary work on halogenated organic extinguishing agents has indicated that the inhibition of the flame reactions may be connected with ionization effects. A preliminary study of electrical effects in dry powders was made, but was dropped because of the difficulties involved. It proved to be very difficult to distinguish between charges on the powder particles induced by the electric field required for measurement, and charges produced by frictional effects, and charges adsorbed on the particles as a result of passing through the plasma in the flame. A sufficient number of interesting effects were observed that it is probable the work will be reactivated at some future date, when it appears that some of the measurement difficulties can be resolved.

3. IONIZATION STUDIES

Since ionization appears to be an almost universal effect in flames and the addition of inhibitors seems to have very profound effects on the steady state concentrations of ions and electrons, it was of interest to try to find out whether preignition reactions can be connected with ionic processes. A pair of concentric tubes were built into a furnace so that a gaseous fuel and air could be heated to the

same temperature prior to mixing. At the exit of the furnace, fuel and air were mixed and the mixture explored with Longmuir probes for the presence of ions and electrons. The temperature was raised slowly until self-ignition occurred, however, no ions could be detected at temperatures close to the self-ignition temperature and at times within 0.2 second of visible ignition. The indications are, therefore, that preignition flame reactions are between neutral species and may even occur between free radicals formed as a result of pyrolysis of the fuel and oxygen.

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